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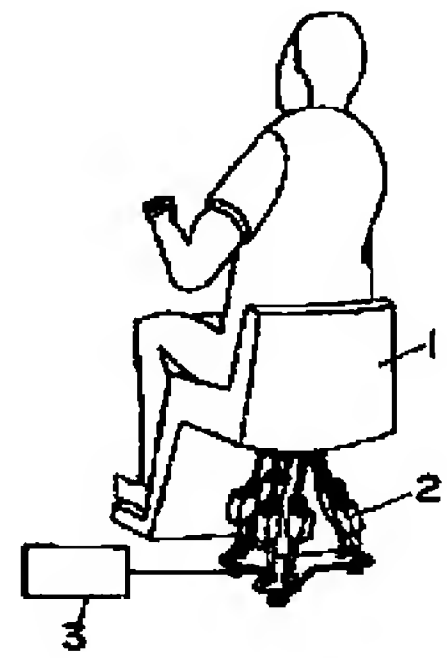
(54) MOVEMENT ANALYZING METHOD AND MOVEMENT AUXILIARY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain stimulation suitable for preventing lumbago and improving a balancing function by providing forcible swinging for the tensing/slackening of a muscle group mainly in a waist part to a seat, measuring three-dimensional position information in the vicinity of the waist and the tensing/slackening state of the muscle group mainly in the waist and corresponding these to each other.
SOLUTION: A controller 3 is constructed by using a computer device, and controls a parallel mechanism 2 based on control information written beforehand from a data input section in a data storage section. For the data input section, a three-dimensional sensor attached to the vicinity of a human coccyx part, a motion capture composed of a plurality of TV cameras for detecting a position by picking up the image of the sphere of reflection attached to the vicinity of the human waist or the like is used. For performing this measuring, measuring time is adjusted beforehand for a surface muscle potential and three-dimensional position information. In other words, based on correspondence by time, the tensing/slackening of a muscle caused by any changes in a waist position is known.



* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1]Movement analytical method giving compulsory rocking to a seat so that a muscle group which makes the lumbar part a subject in the state where it sat down on a seat may become tense and loosen, measuring a state of stress and relaxation of a muscle group which carries out three-dimensional position information and the lumbar part near the lumbar part with a subject, and matching both.
[Claim 2]At the same time it starts Measurement Division of three-dimensional position information near the lumbar part using motion capture which has arranged two or more sets of TV cameras, while a seat is the saddle attached to a horse and attaching a sphere of reflection near the lumbar part, The movement analytical method according to claim 1 starting Measurement Division of surface myoelectric potential of spine standing-up sources by a telemeter, latissimus dorse, a belly oblique muscle on either side, and recti abdominis.
[Claim 3]At the same time a seat is a seat of a simulator which imitates a motion on a saddle and it starts Measurement Division of three-dimensional position information near the lumbar part using a magnetism measuring device, The movement analytical method according to claim 1 starting Measurement Division of surface myoelectric potential of spine standing-up sources by a telemeter, latissimus dorse, a belly oblique muscle on either side, and recti abdominis.
[Claim 4]Movement analytical method extracting information about three-dimensional impaction efficiency near [suitable for training of a muscle group relevant to prevention of low back pain] the lumbar part from a measuring result of Claim 1 thru/or Claim 3.
[Claim 5]Movement analytical method extracting information about three-dimensional impaction efficiency near [suitable for training of a muscle group relevant to balance maintenance] the lumbar part from a measuring result of Claim 1 thru/or Claim 3.
[Claim 6]A seat where a trainee sits down, and a driving means which makes a seat rock by a three dimension, A movement auxiliary device, wherein it has a control means which directs a position of a seat to a driving means and a position of a seat in each time is determined using information about three-dimensional impaction efficiency near [suitable for prevention of low back pain extracted with Claim 4 or movement analytical method of Claim 5] the lumbar part.
[Claim 7]It has a data storage means which stores a unit pattern of a position of a seat for which it asked from information about three-dimensional impaction efficiency near [which has the periodicity extracted corresponding to quick time and gallop of a horse, respectively] the lumbar part, The movement auxiliary device according to claim 6, wherein a control means gives a unit pattern repeatedly read from a data storage means to a driving means.
[Claim 8]It has a data storage means which stores a unit pattern of a position of a seat for which it asked from information about three-dimensional impaction efficiency near [which has the periodicity extracted corresponding to a footpace of a horse] the lumbar part, The movement auxiliary device according to claim 6, wherein a control means superimposes a change pattern accompanied by a sudden change on a unit pattern repeatedly read from a data storage means to irregular timing and gives it to a driving means.
[Claim 9]Claim 6, wherein a driving means is constituted by 3 flexibility so that a seat may be made to rock about a sliding direction, a roll, and a pitch thru/or the movement auxiliary device according to claim 8.
[Claim 10]A movement auxiliary device comprising:
A seat where a trainee sits down.

A driving means which makes a seat rock by a three dimension.
A control means which directs a position of a seat to a driving means.
An electrical-parameter-extraction means to perform orthogonal transformation to a unit pattern of a position of a seat for which it asked from information about three-dimensional impaction efficiency near [which has the periodicity extracted with Claim 4 or movement analytical method of Claim 5] the lumbar part, and to ask for a coefficient group as a parameter, A calculating means given to a control means in quest of position data which consists of two or more elements which show a position of a seat of each time using a parameter stored in a data storage means which memorizes a parameter, and a parameter storage means.

[Claim 11]The movement auxiliary device according to claim 10, wherein said calculating means adds a variation value of a random number to each element of position data and gives it to a control means.
[Claim 12]The movement auxiliary device according to claim 10, wherein said calculating means adds a variation value which has 1/f fluctuation in each element of position data and gives it to a control means.
[Claim 13]The movement auxiliary device according to claim 10, wherein said calculating means carries out the multiplication of the coefficient to at least 1 element of position data and gives it to a control means.
[Claim 14]The movement auxiliary device according to claim 10 making variable a time interval which gives position data to a control means from said calculating means.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the movement auxiliary device which can make prevention of the movement analytical method for creation of data required for prevention of low back pain, or training of a balance function, and low back pain, and movement for training of a balance function perform to a trainee.
[0002]
[Description of the Prior Art]Give a stimulus (generally vibration and rocking) to a trainee, it is made to exercise compulsorily conventionally, and the movement auxiliary device which acquired the specific movement effect is proposed [various]. There are some which were indicated to JP,H7-67924,A as this kind especially proposed for relaxation of low back pain, or prevention of a movement auxiliary device. The movement auxiliary device indicated in this gazette becomes tense and is made to loosen the muscle group which makes the lumbar part a subject, when people have a saddle (seat) which straddles and sits down and do reciprocation moving of the saddle to order.
[0003]
[Problem(s) to be Solved by the Invention]As mentioned above, although there is a certain amount of [that to which back and forth movement of the seat is carried out simply] effect to relaxation and prevention of low back pain, it is not enough, and the high movement auxiliary device of the effect is demanded further. In view of the above-mentioned reason, succeed in this invention, and the purpose, It is in providing the movement analytical method which enabled it to ask for a stimulus suitable for prevention of low back pain, or improvement in a balance function, and providing the movement auxiliary device which trains the muscle group which makes the lumbar part a subject, and aims at prevention of low back pain, and improvement in a balance function.
[0004]
[Means for Solving the Problem]An invention of Claim 1 gives compulsory rocking to a seat so that a muscle group which makes the lumbar part a subject in the state where it sat down on a seat may become tense and loosen, it measures a state of stress and relaxation of a muscle group which carries out three-dimensional position information and the lumbar part near the lumbar part with a subject, and matches both. According to this method, in order to strengthen a muscle group which matches activity of a muscle group which carries out a position change and the lumbar part near the lumbar part with a subject, and is useful for prevention of low back pain, or strengthening of a balance function, it is easily analyzable what kind of position change should be given to the lumbar part. A term of a three-dimensional position is used in a meaning including parallel translation and a rotation. That is, right and left, and displacement and inclination of the upper and lower sides are included approximately.
[0005]An invention of Claim 2 is the saddle which a seat attached to a horse in an invention of Claim 1, Measurement Division of surface myoelectric potential of spine standing-up sources by a telemeter, latissimus dorse, a belly oblique muscle on either side, and recti abdominis is started at the same time it starts Measurement Division of three-dimensional position information near the lumbar part using motion capture which has arranged two or more sets of TV cameras, while attaching a sphere of reflection near the lumbar part. Since motion capture is used in this method, following in footsteps of a motion [a actual horse] is possible.
[0006]An invention of Claim 3 is a seat of a simulator by which a seat imitates a motion on a

saddle in an invention of Claim 1, Measurement Division of surface myoelectric potential of spine standing-up sources by a telemeter, latissimus dorse, a belly oblique muscle on either side, and recti abdominis is started at the same time it starts Measurement Division of three-dimensional position information near the lumbar part using a magnetism measuring device. In this method, it becomes possible to create data indoors, without actually using a horse.

[0007]An invention of Claim 4 extracts information about three-dimensional impaction efficiency near [suitable for training of a muscle group relevant to prevention of low back pain] the lumbar part from a measuring result of Claim 1 thru/or Claim 3. An invention of Claim 5 extracts information about three-dimensional impaction efficiency near [suitable for training of a muscle group relevant to balance maintenance] the lumbar part from a measuring result of Claim 1 thru/or Claim 3.

[0008]An invention of Claim 4 and Claim 5 is a desirable embodiment. A driving means which an invention of Claim 6 makes rock a seat where a trainee sits down, and a seat by a three dimension, It has a control means which directs a position of a seat to a driving means, and a position of a seat in each time is determined by information about three-dimensional impaction efficiency near [suitable for prevention of low back pain extracted with Claim 4 or movement analytical method of Claim 5] the lumbar part. According to this composition, a trainee only sits down on a seat, it can strengthen a muscle group which makes the lumbar part a subject, without doing one's best especially in muscular strengthening, and can perform prevention of low back pain, and strengthening of a balance function.

[0009]An invention of Claim 7 is provided with a data storage means which stores a unit pattern of a position of a seat for which it asked from information about three-dimensional impaction efficiency near [which has the periodicity extracted corresponding to quick time and gallop of a horse, respectively in an invention of Claim 6] the lumbar part, A control means gives a unit pattern repeatedly read from a data storage means to a driving means.

[0010]An invention of Claim 8 is provided with a data storage means which stores a unit pattern of a position of a seat for which it asked from information about three-dimensional impaction efficiency near [which has the periodicity extracted corresponding to a footpace of a horse in an invention of Claim 6] the lumbar part, A control means superimposes a change pattern accompanied by a sudden change on a unit pattern repeatedly read from a data storage means to irregular timing, and gives it to a driving means.

[0011]An invention of Claim 7 and Claim 8 is a desirable embodiment, especially an invention of Claim 7 has an effect in prevention of low back pain, and an invention of Claim 8 has an effect in strengthening of a balance function. In an invention of Claim 6 thru/or Claim 8, an invention of Claim 9 is constituted by 3 flexibility so that a driving means may make a seat rock about a sliding direction, a roll, and a pitch. While according to this composition the same effect as a case where a driving means of 6 flexibility is used can be realized by a driving means of 3 flexibility and generation of a unit pattern becomes easy, cost can be reduced also about a mechanism.

[0012]A driving means which an invention of Claim 10 makes rock a seat where a trainee sits down, and a seat by a three dimension, A control means which directs a position of a seat to a driving means, An electrical-parameter-extraction means to perform orthogonal transformation to a unit pattern of a position of a seat for which it asked from information about three-dimensional impaction efficiency near [which has the periodicity extracted with Claim 4 or movement analytical method of Claim 5] the lumbar part, and to ask for a coefficient group as a parameter, It has a calculating means given to a control means in quest of position data which consists of two or more elements which show a position of a seat of each time using a parameter stored in a data storage means which memorizes a parameter, and a parameter storage means. According to this composition, since what is necessary is just to store a parameter with little data volume in a data storage means as compared with a unit pattern in addition to the same operation as an invention of Claim 6, data volume stored in a data storage means can be reduced.

[0013]In an invention of Claim 10, said calculating means adds a variation value of a random number to each element of position data, and gives an invention of Claim 11 to a control means. In this composition, since a random number is added to position data, if amplitude of a random number added to position data is small set up as compared with amplitude of a time series of position data, Not to mention stopping being a periodic and monotonous motion and an effect of prevention of low back pain or relaxation being acquired, though a motion of a seat reflects

position data, It can prevent weariness arising or coming to maintain balance, without a habituation using muscles of the lumbar part, and a high effect can be acquired to strengthening of a muscle group which makes the lumbar part a subject.
[0014]In an invention of Claim 10, said calculating means adds a variation value which has 1/f fluctuation in each element of position data, and gives an invention of Claim 12 to a control means. According to this composition, since 1/f fluctuation is contained in rocking of a seat, in addition to the same operation as an invention of Claim 11, natural fluctuation which is not a mechanical and unnatural motion will be included in rocking of a seat.
[0015]In an invention of Claim 10, said calculating means carries out the multiplication of the coefficient to at least 1 element of position data, and gives an invention of Claim 13 to a control means. According to this composition, since amplitude which a seat rocks by setting up a coefficient suitably can be changed in addition to the same operation as an invention of Claim 6, according to a user's degree of acquisition and a habituation, strength of rocking is changeable.
[0016]An invention of Claim 14 makes variable a time interval which gives position data to a control means from said calculating means in an invention of Claim 10. According to this composition, by changing a time interval which gives position data to a control means in addition to the same operation as an invention of Claim 6, a repeating cycle of rocking of a seat can change and change can be given to speed which a seat rocks.
[0017]
[Embodiment of the Invention](Embodiment 1) This embodiment moves the seat 1 where a trainee takes a seat according to the parallel mechanism 2 as a driving means, as shown in drawing 1. Motion control of the parallel mechanism 2 is performed by the control device 3 including the control means mentioned later.
[0018]The parallel mechanism 2 is provided with the following.
Standing ways 21 fixed to the regular position as shown in drawing 2.
The movable base 22 supported above the standing ways 21 via the six legs 23.
Each leg 23 is combined via the universal joints 24a and 24b to the standing ways 21 and the movable base 22, respectively. The support pipe 23a which combined each leg 23 with the standing ways 21 via the universal joint 24a, It consists of the rod 23b which consists of a ball screw inserted into the support pipe 23a enabling a free attitude, and the actuator 23c which is provided with the gear which meshes to the rod 23b, and makes the rod 23b move with rotation of right reverse. The tip part of the rod 23b is combined with the movable base 22 via the universal joint 24b. Therefore, if the actuator 23c of each leg 23 is controlled, respectively and the amount of attitudes of the rod 23b is adjusted, the position of the movable base 22 to the standing ways 21 can be adjusted suitably.
[0019]The six legs 23 detach leg 23 comrades which are combined with the standing ways 21 as approached at a time in two, and are combined by approaching to the standing ways 21, and have combined them with the movable base 22. By such composition, control of 6 flexibility of the parallel translation of three directions which intersect perpendicularly mutually, and a rotation centering on an all directions-oriented axis is attained. That is, movement which combined right and left, up-and-down rectilinear-propagation reciprocation moving, and the rotation reciprocation moving around an antero-posterior axis, a lateral axis, and a normal axis is attained approximately, and the movable base 22 moves with 6 flexibility at the seat 1 combined with the movable base 22 as a result. The movable base 22 of the parallel mechanism 2 will perform those compounded operations rather than the operation decomposed into above rectilinear-propagation movements and rotations actually.
[0020]In order to give the following explanation easy, the coordinate system centering on the seat 1 is introduced. That is, an X axial direction and a longitudinal direction are made into Y shaft orientations, a sliding direction is made into Z shaft orientations for the cross direction of the seat 1, and the rectangular coordinate system of a right-hand system which sets the starting point as the center of the standing ways 21 of the parallel mechanism 2 is set up. A deer is carried out, and while the position of the three directions of an X axial direction, Y shaft orientations, and Z shaft orientations is variable, as for the movable base 22 of the parallel mechanism 2, inclination of the circumference of each axis of the X-axis, a Y-axis, and the Z-axis becomes variable. Rotation of the circumference of a pitch and the Z-axis is called [rotation of the circumference of the X-axis] a yaw for rotation of the circumference of a roll and a Y-axis.

[0021]The control device 3 is constituted using computer paraphernalia, and controls the parallel mechanism 2 based on the control information (position information) beforehand written in the data storage part (data storage means) 32 from the data input part 31 to be shown in drawing 3. As the data input part 31, the three-dimensional sensors (a magnetic measuring instrument, a gyro sensor, etc.) attached near people's coccyx are used, or the motion capture etc. which consist of two or more sets of the TV cameras which picturize the sphere of reflection (spherical reflecting object) attached near people's lumbar part, and detect a position are used. Generation of control information is mentioned later.

[0022]The data storage part 32 consists of semiconductor memory, and the control information stored in the data storage part 32 is changed into the length of each leg 23 of the parallel mechanism 2 in the operation part 30 (such a conversion operation is called inverse kinematics calculation). The result of an operation in the operation part 30 is given to the actuator control parts 33. In the actuator control parts 33, the operation amount of the actuator 23c according to the length of each leg 23 for which it asked by the operation part 30 is decided, and the actuator 23c is driven via the actuator 34. The actuator 34 controls the energization to the actuator 23c based on the operation amount decided by the actuator control parts 33. That is, a control means is constituted by the operation part 30, the actuator control parts 33, and the actuator 34 in this embodiment.

[0023]By the way, the control information stored in the data storage part 32, As shown in Table 1, about the seat 1 Position X_i of an X axial direction, Y shaft orientations, and Z shaft orientations, Y_i, and Z_i (i is a positive number), 6 groups with inclination (roll, pitch, yaw) $theta_{Xi}$ of the circumference of the X-axis, the circumference of a Y-axis, and the circumference of the Z-axis, $theta_{Yi}$, and $theta_{Zi}$ (i is a positive number) are set up with a certain time interval. This control information is the time series data generated as mentioned later, and one cycle is stored as a series of vibration patterns with periodicity. Below, such a series of vibration patterns are called unit pattern. This unit pattern is divided with a certain time interval shorter enough than one cycle, and the above-mentioned 6 groups are set up for every pause. In short, the unit pattern is constituted by the time series data of 6 groups.

[0024]

[Table 1]

時刻	X	Y	Z	ロール	ピッチ	ヨー
T_1	X_1	Y_1	Z_1	θ_{x1}	θ_{y1}	θ_{z1}
T_2	X_2	Y_2	Z_2	θ_{x2}	θ_{y2}	θ_{z2}
T_3	X_3	Y_3	Z_3	θ_{x3}	θ_{y3}	θ_{z3}
⋮	⋮	⋮	⋮	⋮	⋮	⋮
T_r	X_r	Y_r	Z_r	θ_{xn}	θ_{yr}	θ_{zr}

[0025]Based on control information (unit pattern) as shown in Table 1, if inverse kinematics calculation is performed to the data of each time of Table 1 by the operation part 30, it can ask for length L_{ij} (i= 1-6 and j are positive numbers) of each leg 23 of the parallel mechanism 2. That is, as shown in Table 2, length L_{ij} of the six legs (it has expressed with the legs 1-6 in Table 2) 23 in a certain time interval is called for.

[0026]

[Table 2]

時刻	脚 1	脚 2	脚 3	脚 4	脚 5	脚 6
T_1	L_{11}	L_{21}	L_{31}	L_{41}	L_{51}	L_{61}
T_2	L_{12}	L_{22}	L_{32}	L_{42}	L_{52}	L_{62}
T_3	L_{13}	L_{23}	L_{33}	L_{43}	L_{53}	L_{63}
⋮	⋮	⋮	⋮	⋮	⋮	⋮
T_r	L_{1n}	L_{2n}	L_{3n}	L_{4n}	L_{5r}	L_{6r}

[0027]By the way, if the seat 1 is made to rock how in order to train the muscle group which makes the lumbar part a subject for the purpose of prevention of low back pain, or improvement in a balance function, it must be analyzed how the muscle group which makes the lumbar part a subject becomes tense and loosens. Then, when what kind of stimulus (rocking) is given to those who are on a simulator which performs the same operation as people and the horse which are carrying out horse riding, If it surveys how the muscle group which makes the lumbar part a subject becomes tense and loosens, in order to train those muscle groups, it understands what kind of stimulus it should give, and understands what kind of thing is desirable as a rocking pattern given to the seat 1.

[0028]The following methods are adopted for extracting a unit pattern. First, the sphere of reflection 11 is attached to the back and right and left of the circumference of the waist of those who ride on a horse like drawing 4. The myoelectric potential measuring sensor 12 used with a telemeter so that the surface myoelectric potential of the musculus erector spinae, latissimus dorse, a belly oblique muscle on either side, and recti abdominis can be measured is attached. A motion of the sphere of reflection 11 is detected by the motion capture which has arranged two or more sets of high sensitivity TV cameras 13 around the transit route (the arrow A shows the move direction) of a horse like drawing 5, and detects the three-dimensional position information near the lumbar part. In the case of this Measurement Division, surface myoelectric potential and three-dimensional position information double the Measurement Division start time. That is, when the position of the waist changes how by matching by time, it can know which muscles became tense and relaxed how. Specifically, three-dimensional position information like drawing 6 (a) and the measurement data of myoelectric potential like drawing 6 (b) will be matched.

[0029]In extraction of a unit pattern, data may be collected about the person who rode on the simulator which moves like a horse. That is, as shown in drawing 7, it may drive according to the parallel mechanism 2 which mentioned above the seat 1a of the saddle shape, and the same rocking as a horse may be given, and the information on stress and relaxation of the muscle group which carries out three-dimensional position information and lumbar part with a subject may be collected. Since this kind of device is used indoors, it can use a magnetism measuring device as a means to collect the three-dimensional position information on the lumbar part. Three-dimensional position information and the measurement data of myoelectric potential are matched by time like those who have ridden on the horse also in this case.

[0030]By the way, it is thought that the low back pain called low back pain, especially posture lumbago is generated in the following processes.That is, a bone comes to support the truncus directly in the portion of the joint of a pelvis and the backbone, without using muscles, such as a sit-up and the back. This is in the state which stands with the belly near at hand as projected. It stops using a back group (especially musculus erector spinae), and stops next, also using a sit-up after that. In this way, a nerve comes to be suppressed and the symptoms of low back pain are shown. Since the symptoms of low back pain develop in such a process, if it is going to prevent low back pain, it turns out that what is necessary is just to strengthen these muscle groups.

[0031]When this invention persons performed measurement mentioned above, the motion of two rhythm centering on the up-and-down motion corresponding to quick time acquired the knowledge of urging activity of the latissimus dorse located in the back of a navel, and the latissimus dorse of the 50-mm upper part, among the gaits of a horse. Surface myoelectric potential was measured from the recti abdominis of a navel part, and a navel by the recti abdominis on 50 mm, the right-

hand side musculus obliquus externus abdominis, the left-hand side musculus obliquus externus abdominis, and the latissimus dorse of the back of a navel, and measured it from the navel here at six places of the latissimus dorse on 50 mm. As a result, the result of urging activity of the muscles of the musculus erector spinae and the back central part to the vibration by quick time among the muscle groups which make the lumbar part a subject was obtained (the three-dimensional position in quick time is shown in drawing 8, and the electromyogram in quick time is shown in drawing 9.). drawing 9 (a) -- the recti abdominis of a navel part, and the figure (b) -- a navel -- the right-hand side musculus obliquus externus abdominis and the figure (d) are shown from the latissimus dorse of the back to the left-hand side musculus obliquus externus abdominis and the figure (e), and, as for the recti abdominis on 50 mm, and the figure (c), the figure (f) shows the latissimus dorse on 50 mm from a navel. The following electromyograms are also the same. The motion of three rhythm which emphasizes the rotation to order focusing on the up-and-down motion corresponding to gallop acquired the knowledge of urging activity of recti abdominis (the three-dimensional position in gallop is shown in drawing 10, and the electromyogram in gallop is shown in drawing 11). That is, if the motion by quick time and gallop is combined, a sit-up and the back can be strengthened. As the onset process of low back pain mentioned above explained on the other hand, the symptoms of low back pain develop by not using muscles, such as a sit-up and the back, If a sit-up and the back are strengthened, since the onset of low back pain can be prevented, if rocking corresponding to quick time and gallop is given, the onset of low back pain can be prevented.

[0032]According to an above-mentioned viewpoint, the unit pattern corresponding to quick time and gallop is created based on data measuring, and it stores in the data storage part 32. In aiming at prevention of low back pain, it connects serially the unit pattern of quick time as shown in drawing 12 (a) and (b), and gallop stored in the data storage part 32 (in the example of a graphic display, the cycle of T1 and the unit pattern of gallop is set to T2 for the cycle of the unit pattern of quick time). However, since change becomes discontinuous when connecting a different unit pattern, it ties in order to connect both the unit pattern smoothly like drawing 12 (c), and interpolates using a pattern (the cycle of the bond pattern is made into T3).

[0033]Being strengthened with on the other hand training the muscle group which makes the lumbar part a subject also about a balance function is known. According to this invention persons' research, the movement toward the four cycle cadence centering on the up-and-down motion corresponding to a footpace stimulates activity of the musculus obliquus externus abdominis on either side among the gaits of a horse, and the knowledge of using a sit-up to the shake of right and left is acquired (the three-dimensional position in a footpace is shown in drawing 13, and the electromyogram in a footpace is shown in drawing 14).

[0034]However, in order to come to predict a motion in about 2 to 3 seconds to a periodic shake and to strengthen a balance function with a normal person's balance retaining function, there are few effects only at a periodic shake. So, at this embodiment, the abrupt change is given to irregular timing with the acceleration within the limits at which safety is maintained. That is, a change pattern like drawing 15 (b) which contains an abrupt change with a unit pattern like drawing 15 (a) is prepared for the data storage part 32, It is superimposing a change pattern like drawing 15 (b) to irregular timing, although the unit pattern of drawing 15 (a) is connected serially fundamentally, It enables it to give an abrupt change like drawing 15 (c) (in the example of a graphic display, the cycle of the unit pattern of a footpace is set to T4, and the period which superimposes the change pattern is shown as T5).

[0035]As explained above, various kinds of unit patterns, change patterns, etc. are stored in the data storage part 32, and a rocking pattern is generated by connecting a unit pattern serially, interpolating, or superimposing in the operation part 30. Thus, since a rocking pattern is generated by various kinds combining two or more unit patterns, though a small number of unit pattern is used comparatively, a complicated rocking pattern can be generated, and a rocking pattern can be generated economically.

[0036]The rocking pattern generated by the operation part 30 is given to the parallel mechanism 2 through the actuator control parts 33 and the actuator 34 as mentioned above, and the seat 1 rocks it by operation of the parallel mechanism 2. According to a rocking pattern, it can use for prevention of low back pain, or strengthening of a balance function as mentioned above.

(Embodiment 2) Although Embodiment 1 is driving the seat 1 with 6 flexibility of an X axial

direction, Y shaft orientations, Z shaft orientations, and inclination (a roll, a pitch, yaw) of the circumference of the X-axis, the circumference of a Y-axis, and the circumference of the Z-axis, an effect is acquired by prevention of low back pain, and strengthening of a balance function even if it drives the seat 1 with 3 flexibility. In particular, the knowledge that there was a high effect was acquired in Z shaft orientations, a pitch, and the combination of the roll.

[0037] When the seat 1 was driven using the unit pattern of a footpace and the surface myoelectric potential of various muscles was measured about three persons, a result like drawing 16 thru/or drawing 18 was obtained for every everybody. Nine kinds shown in each figure of results The X-axis (**), a Y-axis (**), the Z-axis (**), Only a yaw (**), a pitch (**), and one flexibility each of a roll (**) are results when the seat 1 is driven by nine kinds of each of the combination (**) of a pitch and a roll, the combination (**) of the X-axis, a pitch, and a roll, and the combination (**) of the Z-axis, a pitch, and a roll. It is the percentage of the myoelectric potential in the above-mentioned drive over the myoelectric potential at the time of driving the horizontal axis of each figure by a muscular kind, and driving a vertical axis with 6 flexibility. The result similarly measured about gallop is shown in drawing 19 thru/or drawing 21.

[0038] Although there is dispersion in these measurement results, even when the seat 1 is driven with Z shaft orientations, a pitch, and 3 flexibility of a roll, it turns out that the muscle group which has an effect in prevention of low back pain or strengthening of a balance function can be trained. Therefore, as compared with the case where a parallel mechanism is used as a driving means, reduction of large cost is attained by making the seat 1 rock using the driving means of such 3 flexibility. Other composition and operations are the same as that of Embodiment 1.

[0039] (Embodiment 3) According to Embodiment 1, although the unit pattern is stored in the data storage part 32, when the number of the time series data of 6 groups which constitute a unit pattern increases, the big storage capacity as the data storage part 32 will be required. That the number of time series data increases is a case where the time interval of the time series data which constitute the unit pattern was set up short, or the cycle of a unit pattern becomes long.

[0040] So, in this embodiment, while reducing the data volume stored in the data storage part 32, discrete orthogonal transformation has been performed to the time series data which constitute a unit pattern so that grasp of the characteristic of a unit pattern may become easy. A coefficient sequence is extracted by performing discrete Fourier transform to the time series data which specifically constitute a unit pattern. If orthogonal transformation is generally performed, since the feature will concentrate on the coefficient of the low next, even if it omits a high order coefficient, inverse orthogonal transformation can restore the information near the original information. Then, if distortion is allowed to increase somewhat, data volume can be further reduced by omitting a high order coefficient. Thus, if stored in the data storage part 32 by making into a parameter the coefficient sequence searched for from the time series data which constitute a unit pattern, It will mean carrying out the data compression of the unit pattern, and the storage capacity required of the data storage part 32 will be reduced as compared with the case where a unit pattern is stored in the data storage part 32. Since it is concentrating on the coefficient of the low next, the feature of a unit pattern can grasp the feature of a unit pattern easily with a parameter.

[0041] If the parameter stored in the data storage part 32 is used, it can ask for 6 groups of the position of the seat 1 in each time. Such 6 groups are called position data. That is, in the operation part 30, it asks for the position data for every time by inverse orthogonal transformation (inverse Fourier transform) using a parameter. The data flow of Embodiment 1 and the data flow of this embodiment are shown in drawing 22 and drawing 23, respectively. The measuring part 31a from which the data input part 31 detects the three-dimensional position information near people's lumbar part in Embodiment 1 as shown in drawing 22 (a), It comprises the treating part 31b which extracts a unit pattern from the measuring part 31a, and the unit data for which it asked by the treating part 31b is stored in the data storage part 32. Processing which stores a unit pattern in the data storage part 32 is performed apart from the processing which drives the parallel mechanism 2 (it is got blocked, and if processing which drives the parallel mechanism 2 is made into on-line, carried out off-line). When driving the parallel mechanism 2, the unit pattern stored in the data storage part 32 is read like drawing 23 (b), and the signal which drives the parallel mechanism 2 through the control section 35 which consists of the operation part 30, the actuator control parts 33, and the actuator 34 is generated. The operation part 30 is made to serve a double purpose also as a calculating means as mentioned above.

[0042]The measuring part 31a from which the data input part 31, on the other hand, detects the three-dimensional position information near people's lumbar part by this embodiment as shown in drawing 23 (a), It is constituted by the treating part 31b which extracts a unit pattern from the measuring part 31a, and the electrical-parameter-extraction part 31c which performs discrete Fourier transform to a unit pattern, and extracts a parameter. The parameter for which it asked in the electrical-parameter-extraction part 31c is stored in the data storage part 32. For example, a parameter can be obtained in a form as shown in Table 3 to the unit pattern shown in Table 1. It is n>N here. That is, the parameter of the number becomes less than the time series data of a unit pattern.

[0043]

[Table 3]

X	Y	Z	ロール	ピッチ	ヨー
A_{X1}	A_{Y1}	A_{Z1}	$A\theta_{X1}$	$A\theta_{Y1}$	$A\theta_{Z1}$
A_{X2}	A_{Y2}	A_{Z2}	$A\theta_{X2}$	$A\theta_{Y2}$	$A\theta_{Z2}$
A_{X3}	A_{Y3}	A_{Z3}	$A\theta_{X3}$	$A\theta_{Y3}$	$A\theta_{Z3}$
.....	.....	.....	.....	.....	.....
A_{XN}	A_{YN}	A_{ZN}	$A\theta_{XN}$	$A\theta_{YN}$	$A\theta_{ZN}$

[0044]When driving the parallel mechanism 2, as shown in drawing 23 (b), inverse Fourier transform is performed to the parameter stored in the data storage part 32 by the operation part 30 which is a calculating means, and it asks for the position data of each time. Position data is generated in a form as 6 groups of each time t of every as shown in Table 4.

[0045]

[Table 4]

時刻	X	Y	Z	ロール	ピッチ	ヨー
t	X_t	Y_t	Z_t	θ_{Xt}	θ_{Yt}	θ_{Zt}

[0046]The operation part 30 performs inverse kinematics calculation like Embodiment 1, for example, as shown in Table 5, it asks for length L_{it} (it is shown that i= 1-6 and t are data of the time t) of each leg 23 of the parallel mechanism 2 from position data.

[0047]

[Table 5]

時刻	脚1	脚2	脚3	脚4	脚5	脚6
t	L_{1t}	L_{2t}	L_{3t}	L_{4t}	L_{5t}	L_{6t}

[0048]Length L_{it} of the leg 23 of the parallel mechanism 2 is given to the parallel mechanism 2 through the control section 35 which consists of the actuator control parts 33 and the actuator 34, and the parallel mechanism 2 drives it. By the way, the case where the parallel mechanism 2 is driven by repetition of a unit pattern as mentioned above, Since the rocking pattern for every cycle becomes the same when driving the parallel mechanism 2 using a parameter, the seat 1 becomes a periodic and monotonous motion and there is a problem of a user getting bored or coming to maintain balance without a user's getting used to a motion and using the waist. Then, since change is given to movement of the seat 1, there is independent [no], it combines and various kinds of following art is used.

[0049]that is, it is shown in Table 6 -- as -- each element of 6 groups of position data (or time series data which constitute a unit pattern) -- variation value $alpha_{Nt}$ (N=X, Y, Z, $theta_X$, $theta_Y$, and $theta_Z$.) t -- the data of the time t -- meaning -- it asks for length L_{it} of the leg 23 of the

parallel mechanism 2 by performing inverse kinematics conversion to the position data which added and added variation value $alpha_{Nt}$. Variation value $alpha_{Nt}$ can make it generate here by random numbers. It may be variation value $alpha_{Nt}$ which contains 1/f fluctuation. However, the amplitude of variation value $alpha_{Nt}$ is set up smaller than the amplitude of the original position data, and even after adding variation value $alpha_{Nt}$, it is made to be reflected in position data.

[0050]

[Table 6]

時刻	X	Y	Z	ロール	ピッチ	ヨー
t	X_{-} $+\alpha_{x1}$	Y_{-} $+\alpha_{y1}$	Z_{-} $+\alpha_{z-}$	θ_{x-} $+\alpha\theta_{xt}$	θ_{y-} $+\alpha\theta_{yt}$	θ_{z1} $+\alpha\theta_{z-}$

[0051]In order to give change to rocking of the seat 1, as shown in Table 7, the multiplication of the coefficient $beta_N$ (N=X, Y, Z, $theta_X$, $theta_Y$, $theta_Z$) is carried out to at least one of each elements of 6 groups which constitute position data. In Table 7, the multiplication of the coefficient $beta_N$ is carried out to all the elements. Thus, if the multiplication of the coefficient $beta_N$ is carried out, the amplitude which makes the seat 1 rock with the size of coefficient $beta_N$ can be changed.

[0052]

[Table 7]

時刻	X	Y	Z	ロール	ピッチ	ヨー
t	β_x X_{-}	β_y Y_t	β_z Z_{-}	$\beta\theta_x$ $\cdot\theta_{xt}$	$\beta\theta_y$ $\cdot\theta_{y-}$	$\beta\theta_z$ $\cdot\theta_{z-}$

[0053]If the time interval which carries out inverse kinematics conversion of the 6 groups which constitute position data as shown in Table 8 is changed (time is multiplied by the coefficient gamma in Table 8), the cycle of position data can be changed and the speed of a motion of the seat 1 can be changed. Other composition and operations are the same as that of Embodiment 1.

[0054]

[Table 8]

時刻	X	Y	Z	ロール	ピッチ	ヨー
$\gamma\tau$	X_t	Y_t	Z_{-}	θ_{x1}	θ_{yt}	θ_{zt}

[0055]

[Effect of the Invention]The invention of Claim 1 gives compulsory rocking to a seat so that the muscle group which makes the lumbar part a subject in the state where it sat down on the seat may become tense and loosen, It is what measures the state of the stress and relaxation of a muscle group which makes a subject the three-dimensional position information and lumbar part near the lumbar part, and matches both, In order to strengthen the muscle group which matches activity of the muscle group which carries out the position change and the lumbar part near the lumbar part with a subject, and is useful for prevention of low back pain, or strengthening of a balance function, it is easily analyzable what kind of position change should be given to the lumbar part.

[0056]At the same time it starts Measurement Division of the three-dimensional position information near the lumbar part using the motion capture which has arranged two or more sets of TV cameras, while a seat is the saddle attached to the horse and attaching a sphere of reflection near the lumbar part like the invention of Claim 2, Since motion capture is used, following in footsteps of a motion [a actual horse] is possible what starts Measurement Division of the surface myoelectric potential of the spine standing-up sources by a telemeter, latissimus dorse, a belly oblique muscle on either side, and recti abdominis.

[0057]A seat is a seat of the simulator which imitates the motion on a saddle like the invention of

Claim 3, In what starts Measurement Division of the surface myoelectric potential of the spine standing-up sources by a telemeter, latissimus dorse, a belly oblique muscle on either side, and recti abdominis, it becomes possible to create data indoors, without actually running a horse at the same time it starts Measurement Division of the three-dimensional position information near the lumbar part using a magnetism measuring device.

[0058]Like the invention [**** / extracting the information about the three-dimensional impaction efficiency near / suitable for training of the muscle group relevant to prevention of low back pain / the lumbar part from the measuring result of Claim 1 thru/or Claim 3 like the invention of Claim 4] of Claim 5, If the information about the three-dimensional impaction efficiency near [suitable for training of the muscle group relevant to balance maintenance] the lumbar part is extracted from the measuring result of Claim 1 thru/or Claim 3, a motion of near the lumbar part suitable for prevention of low back pain or training of balance maintenance can be known.

[0059]The driving means which the invention of Claim 6 makes rock the seat where a trainee sits down, and a seat by a three dimension, Have a control means which directs the position of a seat to a driving means, the position of the seat in each time is determined by the information about the three-dimensional impaction efficiency near [suitable for prevention of the low back pain extracted with Claim 4 or the movement analytical method of Claim 5] the lumbar part, and a trainee only sits down on a seat, The muscle group which makes the lumbar part a subject can be strengthened without doing one's best especially in muscular strengthening, and there is an advantage that prevention of low back pain and strengthening of a balance function can be performed.

[0060]It has a data storage means which stores the unit pattern of the position of a seat for which it asked from the information about the three-dimensional impaction efficiency near [which has the periodicity extracted corresponding to the quick time and gallop of a horse, respectively like the invention of Claim 7] the lumbar part, If the unit pattern repeatedly read from a data storage means is given to a driving means, a control means, Prevention of low back pain has an effect and it has a data storage means which stores the unit pattern of the position of a seat for which it asked from the information about the three-dimensional impaction efficiency near [which has the periodicity extracted corresponding to the footpace of a horse like the invention of Claim 8] the lumbar part, If a control means superimposes the change pattern accompanied by a sudden change on the unit pattern repeatedly read from a data storage means to irregular timing and it is given to a driving means, strengthening of a balance function has an effect.

[0061]A driving means like the invention of Claim 9 by what is constituted by 3 flexibility so that a seat may be made to rock about a sliding direction, a roll, and a pitch. While the same effect as the case where the driving means of 6 flexibility is used can be realized by the driving means of 3 flexibility and generation of a unit pattern becomes easy, it has the advantage that cost can be reduced also about a mechanism.

[0062]The driving means which the invention of Claim 10 makes rock the seat where a trainee sits down, and a seat by a three dimension, The control means which directs the position of a seat to a driving means, An electrical-parameter-extraction means to perform orthogonal transformation to the unit pattern of the position of a seat for which it asked from the information about the three-dimensional impaction efficiency near [which has the periodicity extracted with Claim 4 or the movement analytical method of Claim 5] the lumbar part, and to ask for a coefficient group as a parameter, It is a thing provided with the calculating means given to a control means in quest of the position data which consists of two or more elements which show the position of the seat of each time using the parameter stored in the data storage means which memorizes a parameter, and the parameter storage means, Since what is necessary is just to store the parameter with little data volume in the data storage means as compared with the unit pattern in addition to the same effect as the invention of Claim 6, there is an advantage that the data volume stored in the data storage means can be reduced.

[0063]A calculating means like the invention of Claim 11 by what adds the variation value of a random number to each element of position data, and is given to a control means. Since the random number is added to position data, if the amplitude of the random number added to position data is small set up as compared with the amplitude of the time series of position data, Not to mention stopping being a periodic and monotonous motion and the effect of prevention of low back pain or relaxation being acquired, though a motion of a seat reflects position data, It can prevent

weariness arising or coming to maintain balance, without a habituation using the muscles of the lumbar part, and a high effect can be acquired to strengthening of the muscle group which makes the lumbar part a subject.

[0064]In what adds the variation value to which a calculating means has 1/f fluctuation in each element of position data like the invention of Claim 12, and is given to a control means. Since 1/f fluctuation is contained in rocking of a seat, in addition to the same effect as the invention of Claim 11, it can be made the motion including the natural fluctuation which is not a mechanical and unnatural motion about a seat. A calculating means like the invention of Claim 13 by what carries out the multiplication of the coefficient to at least 1 element of position data, and is given to a control means. Since the amplitude which a seat rocks by setting up a coefficient suitably can be changed in addition to the same effect as the invention of Claim 6, there is an advantage that the strength of rocking is changeable according to a user's degree of acquisition and habituation.

[0065]By what was made variable, the time interval which gives position data to a control means from a calculating means like the invention of Claim 14. By changing the time interval which gives position data to a control means in addition to the same effect as the invention of Claim 6, the repeating cycle of rocking of a seat changes and there is an advantage that change can be given to the speed which a seat rocks.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a perspective view of Embodiment 1.
[Drawing 2]It is a perspective view showing the parallel mechanism used for the same as the above.
[Drawing 3]It is a block diagram same as the above.
[Drawing 4]It is an explanatory view of three-dimensional position information same as the above and the measuring method of myoelectric potential.
[Drawing 5]It is an explanatory view of the measuring method of three-dimensional position information same as the above.
[Drawing 6]It is a figure showing three-dimensional position information same as the above and the measurement result of myoelectric potential.
[Drawing 7]An example of the simulator used for the same as the above is shown, (a) is a side view and (b) is a rear elevation.
[Drawing 8]It is a figure showing the three-dimensional position in quick time in the same as the above.
[Drawing 9]It is a figure showing the electromyogram in quick time in the same as the above.
[Drawing 10]It is a figure showing the three-dimensional position in gallop in the same as the above.
[Drawing 11]It is a figure showing the electromyogram in gallop in the same as the above.
[Drawing 12]It is an explanatory view showing generation of the rocking pattern of the low back pain prevention from a unit pattern in the same as the above.
[Drawing 13]It is a figure showing the three-dimensional position in a footpace in the same as the above.
[Drawing 14]It is a figure showing the electromyogram in a footpace in the same as the above.
[Drawing 15]It is an explanatory view showing generation of the rocking pattern of balance function strengthening from a unit pattern in the same as the above.
[Drawing 16]It is a figure showing the measurement result corresponding to Embodiment 2.
[Drawing 17]It is a figure showing the measurement result corresponding to Embodiment 2.
[Drawing 18]It is a figure showing the measurement result corresponding to Embodiment 2.
[Drawing 19]It is a figure showing the measurement result corresponding to Embodiment 2.
[Drawing 20]It is a figure showing the measurement result corresponding to Embodiment 2.
[Drawing 21]It is a figure showing the measurement result corresponding to Embodiment 2.
[Drawing 22]It is a block diagram of Embodiment 1 shown as a comparative example with Embodiment 3.
[Drawing 23]It is a block diagram showing Embodiment 3.
[Description of Notations]
1 Seat
2 Parallel mechanism
3 Control device
11 Sphere of reflection
12 Myoelectric potential measuring sensor
13 TV camera
30 Operation part

31 Data input part
31a Measuring part
31b Treating part
31c Electrical- parameter- extraction part
32 Data storage part
33 Actuator control parts
34 Actuator
35 Control section

[Translation done.]

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最終頁に続く

(54)【発明の名称】　運動分析方法および運動補助装置

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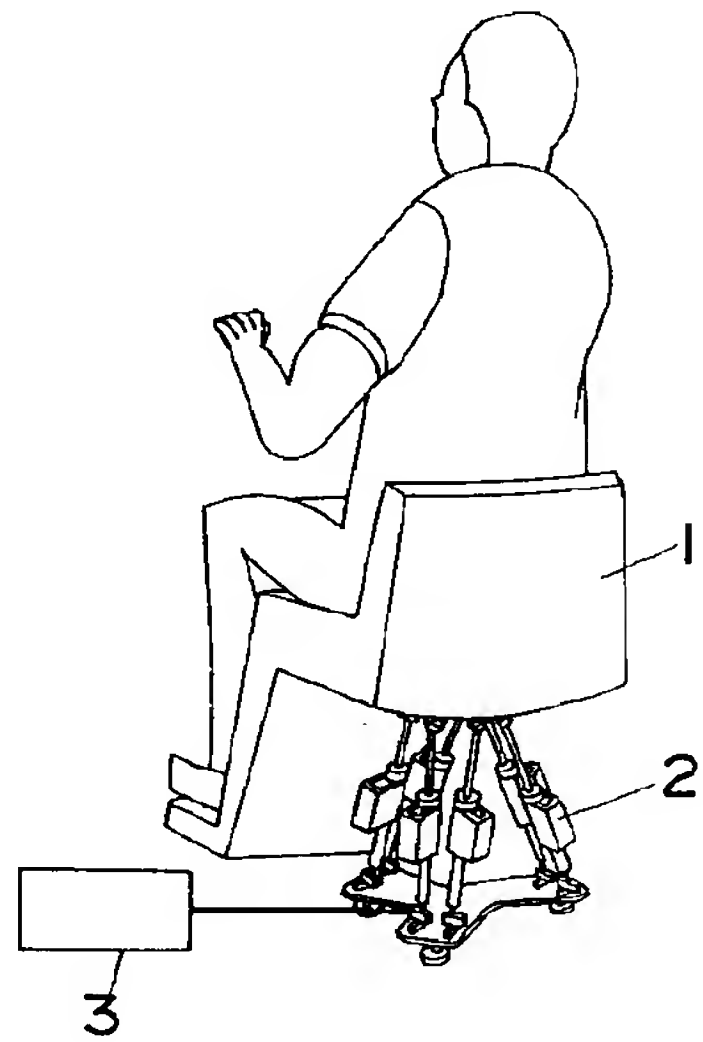

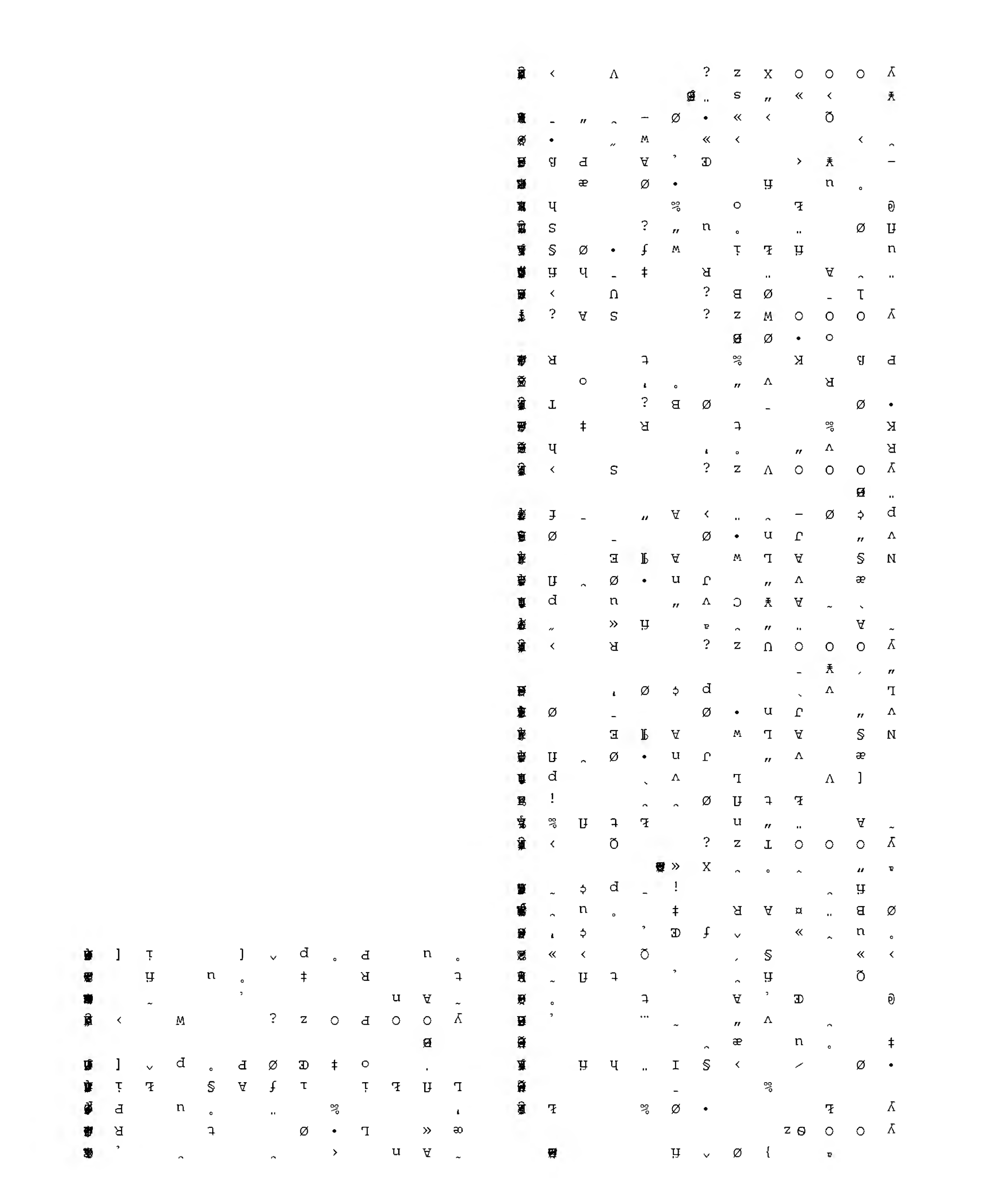

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T_2	X_2	Y_2	Z_2	θ_{X2}	θ_{Y2}	θ_{Z2}
T_3	X_3	Y_3	Z_3	θ_{X3}	θ_{Y3}	θ_{Z3}
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T_n	X_n	Y_n	Z_n	θ_{Xn}	θ_{Yn}	θ_{Zn}

時刻	脚 1	脚 2	脚 3	脚 4	脚 5	脚 6
T_1	L_{11}	L_{21}	L_{31}	L_{41}	L_{51}	L_{61}
T_2	L_{12}	L_{22}	L_{32}	L_{42}	L_{52}	L_{62}
T_3	L_{13}	L_{23}	L_{33}	L_{43}	L_{53}	L_{63}
⋮	⋮	⋮	⋮	⋮	⋮	⋮
T_n	L_{1n}	L_{2n}	L_{3n}	L_{4n}	L_{5n}	L_{6n}

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A_{XN}	A_{YN}	A_{ZN}	$A\theta_{XN}$	$A\theta_{YN}$	$A\theta_{ZN}$

時刻	X	Y	Z	ロール	ピッチ	ヨー
t	X_t	Y_t	Z_t	θ_{Xt}	θ_{Yt}	θ_{Zt}

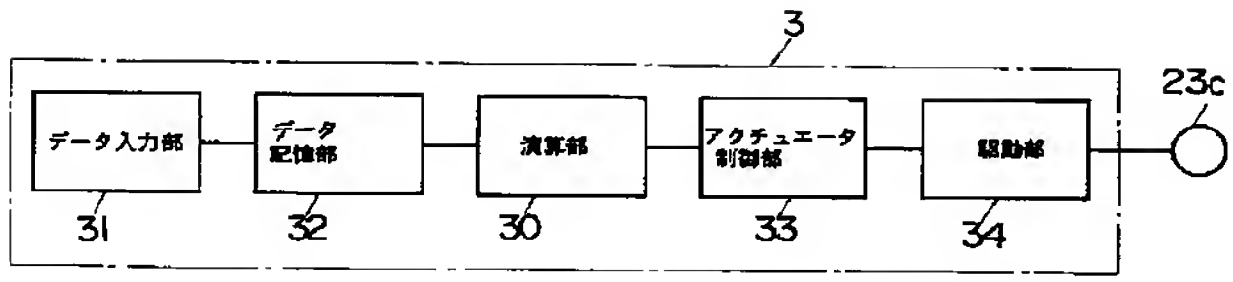
時刻	脚 1	脚 2	脚 3	脚 4	脚 5	脚 6
t	L_{1t}	L_{2t}	L_{3t}	L_{4t}	L_{5t}	L_{6t}

時刻	X	Y	Z	ロール	ピッチ	ヨー
t	$X_t + \alpha_{Xt}$	$Y_t + \alpha_{Yt}$	$Z_t + \alpha_{Zt}$	$\theta_{Xt} + \alpha\theta_{Xt}$	$\theta_{Yt} + \alpha\theta_{Yt}$	$\theta_{Zt} + \alpha\theta_{Zt}$

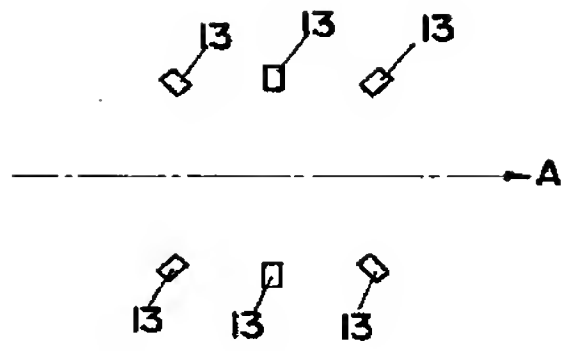
時刻	X	Y	Z	ロール	ピッチ	ヨー
t	$\beta_X X_t$	$\beta_Y Y_t$	$\beta_Z Z_t$	$\beta\theta_X \cdot \theta_{Xt}$	$\beta\theta_Y \cdot \theta_{Yt}$	$\beta\theta_Z \cdot \theta_{Zt}$

時刻	X	Y	Z	ロール	ピッチ	ヨー
γ t	X_t	Y_t	Z_t	θ_{Xt}	θ_{Yt}	θ_{Zt}

y } 図



y } 図



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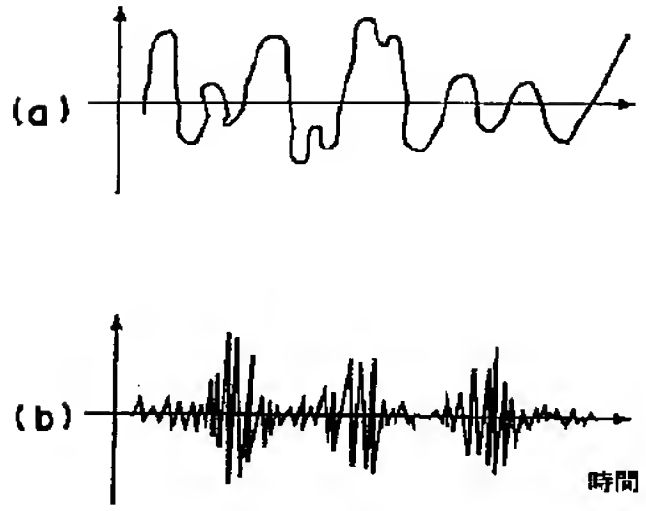

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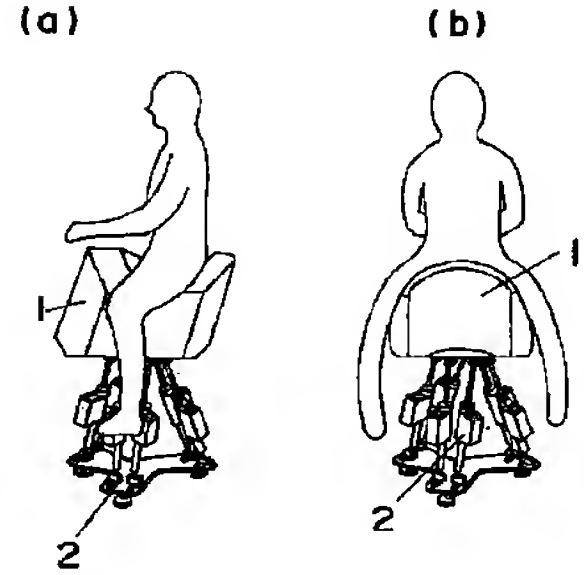

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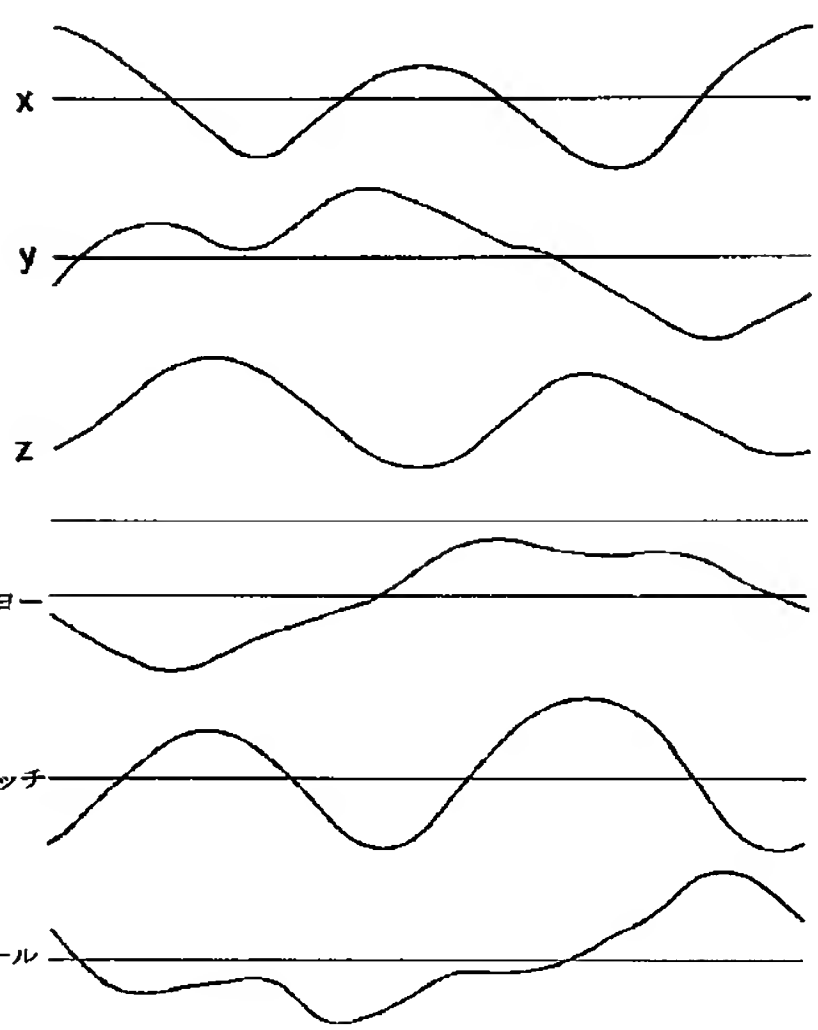
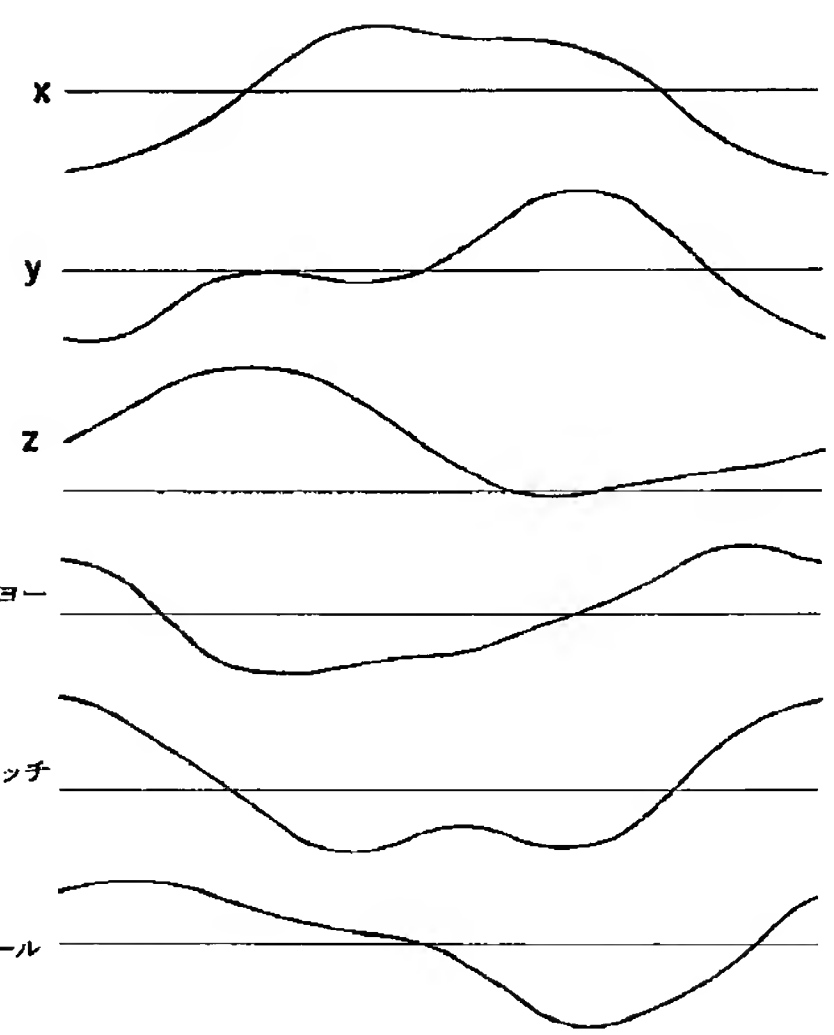


y } 図



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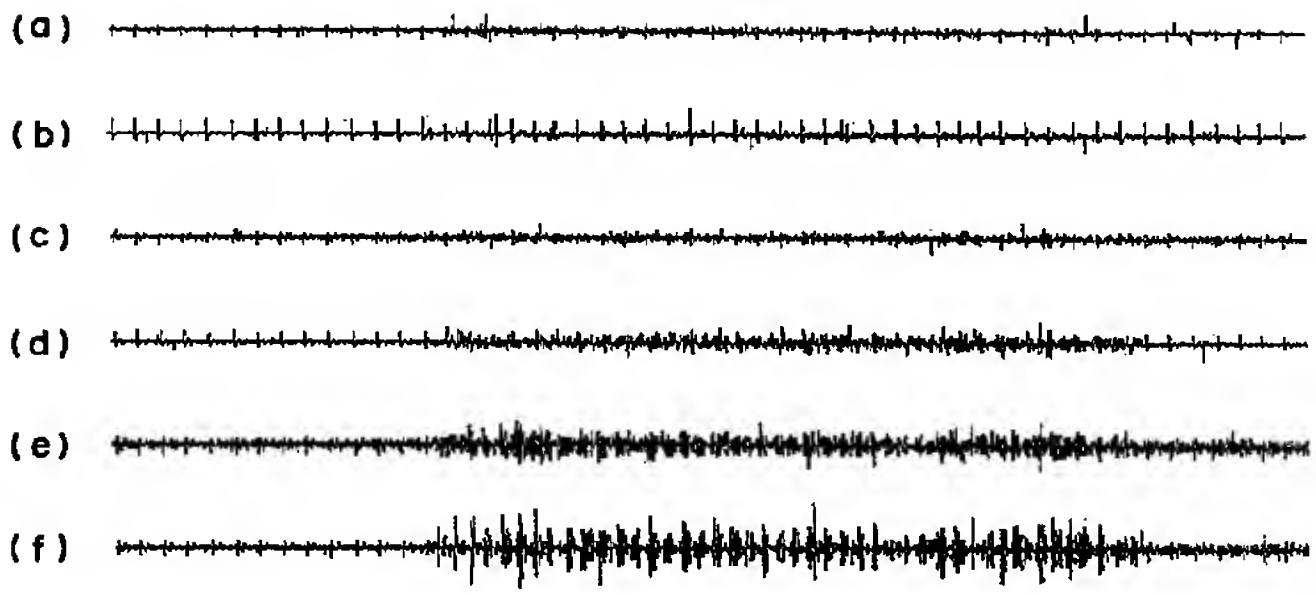
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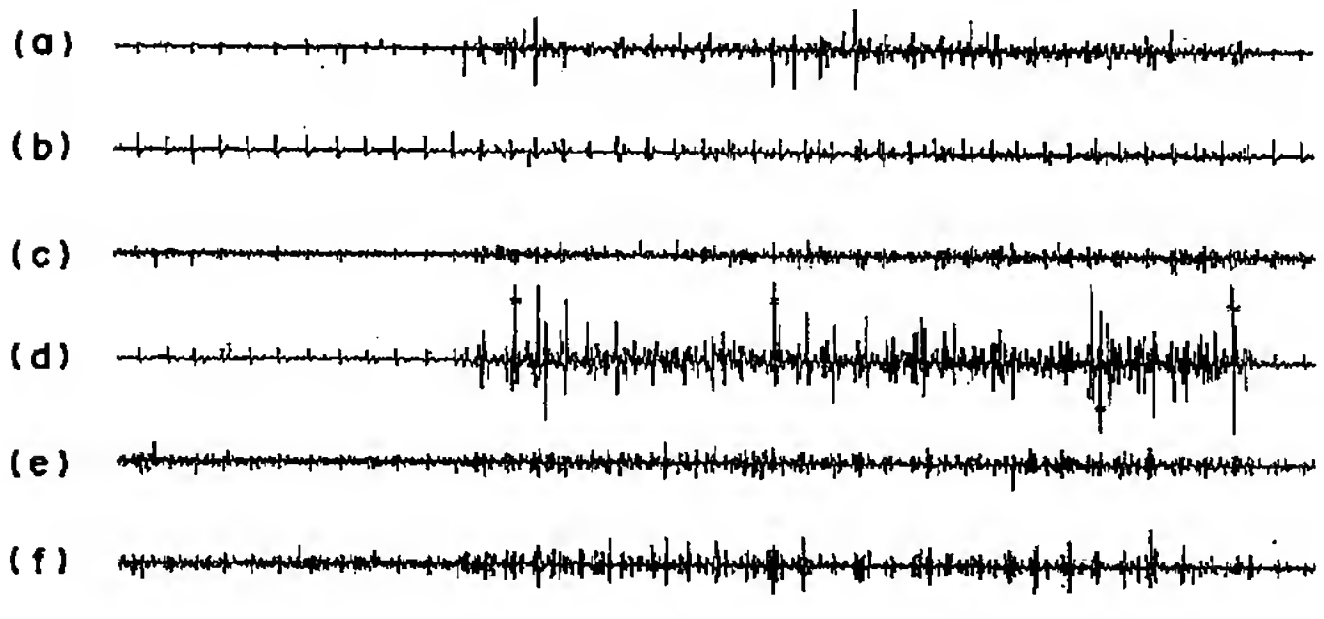
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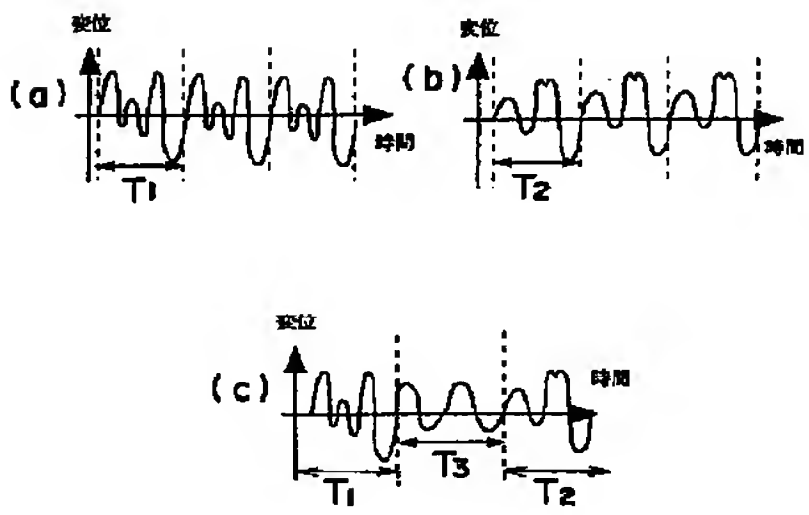
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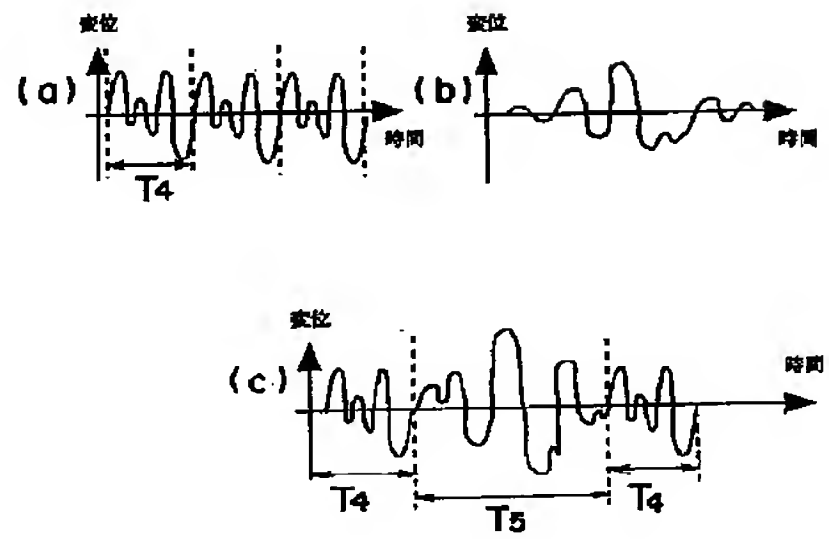
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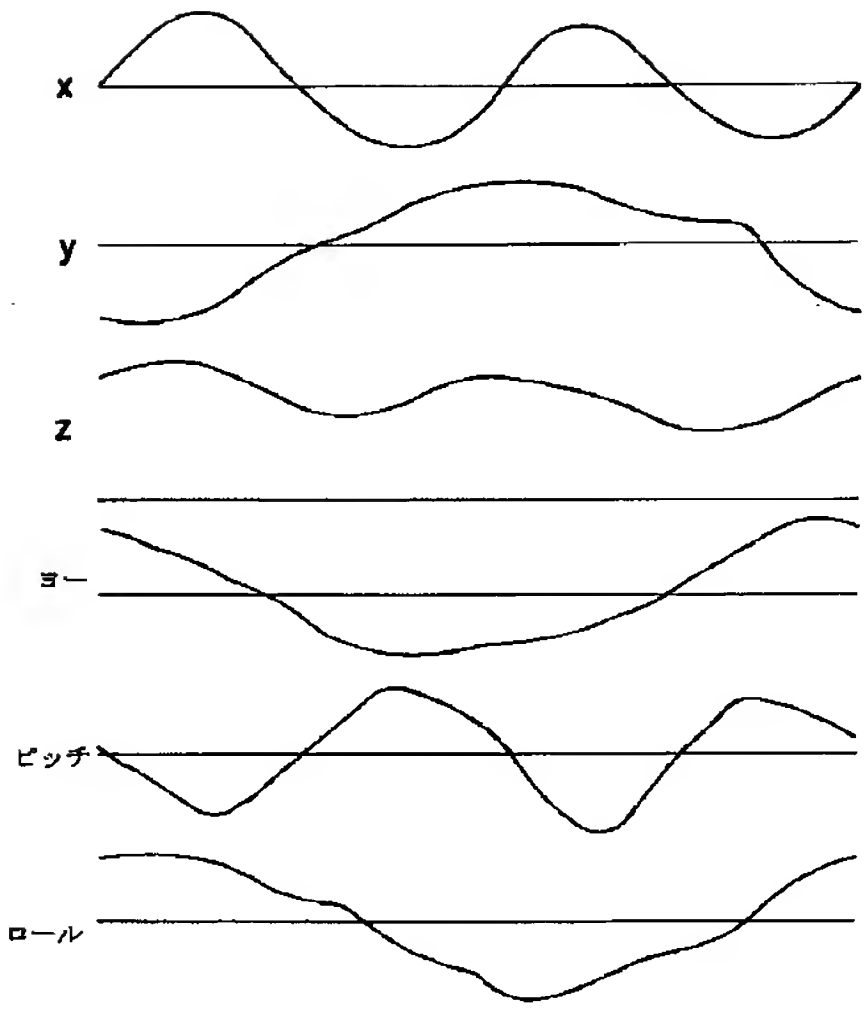
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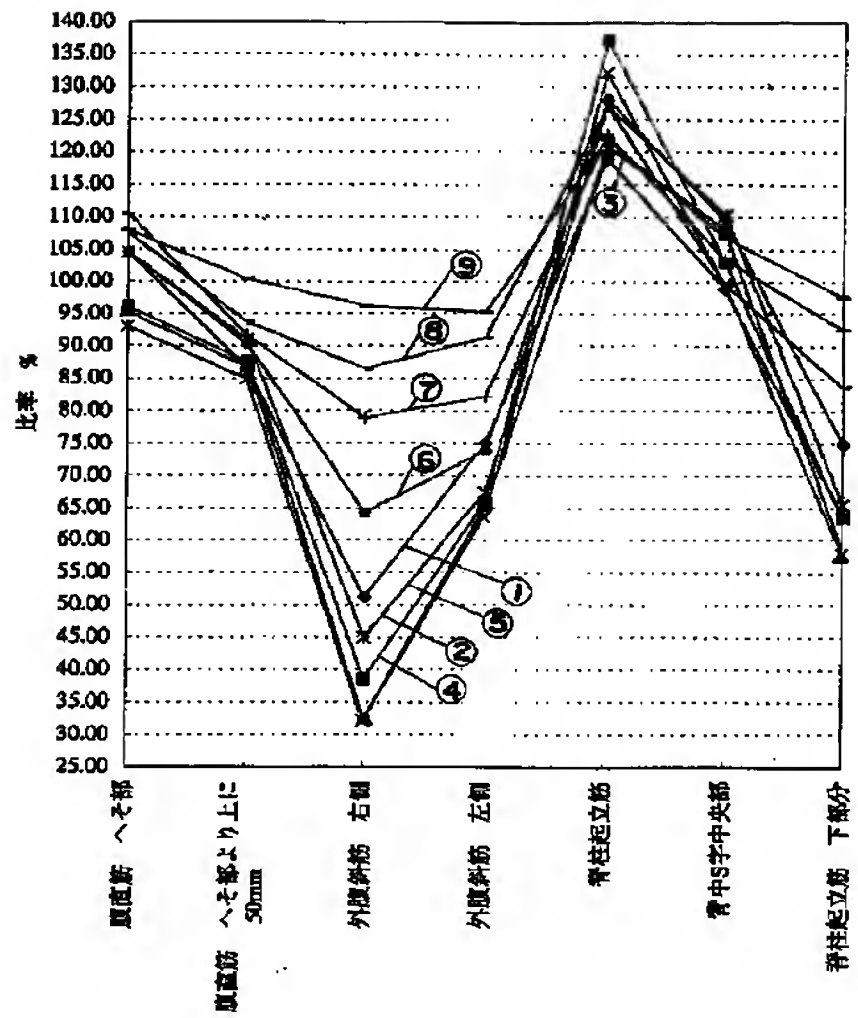
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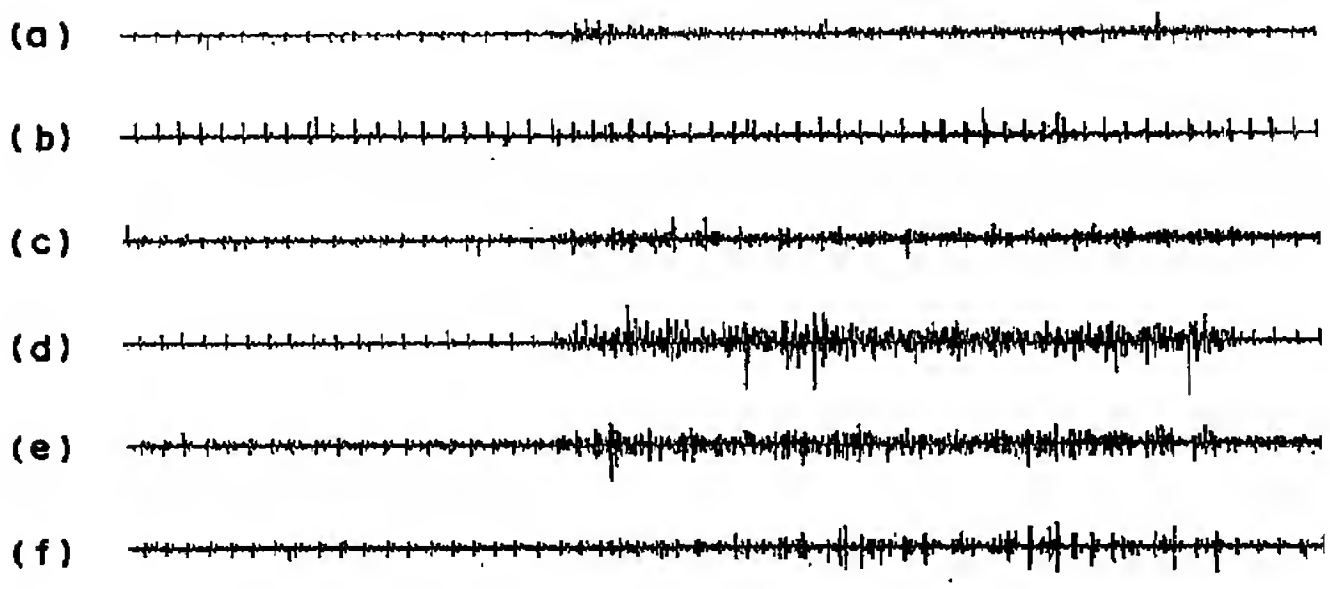
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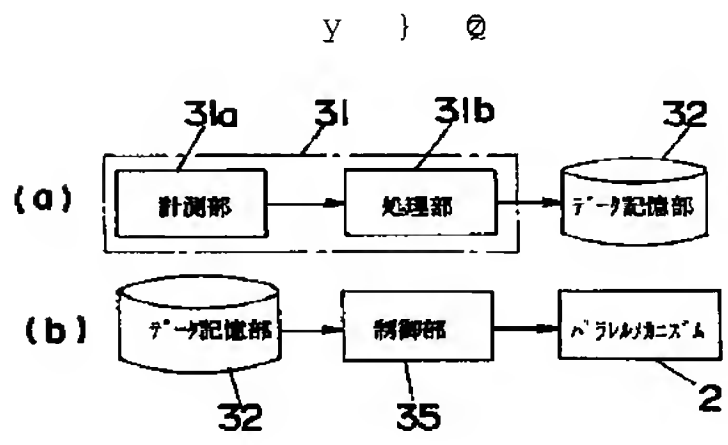
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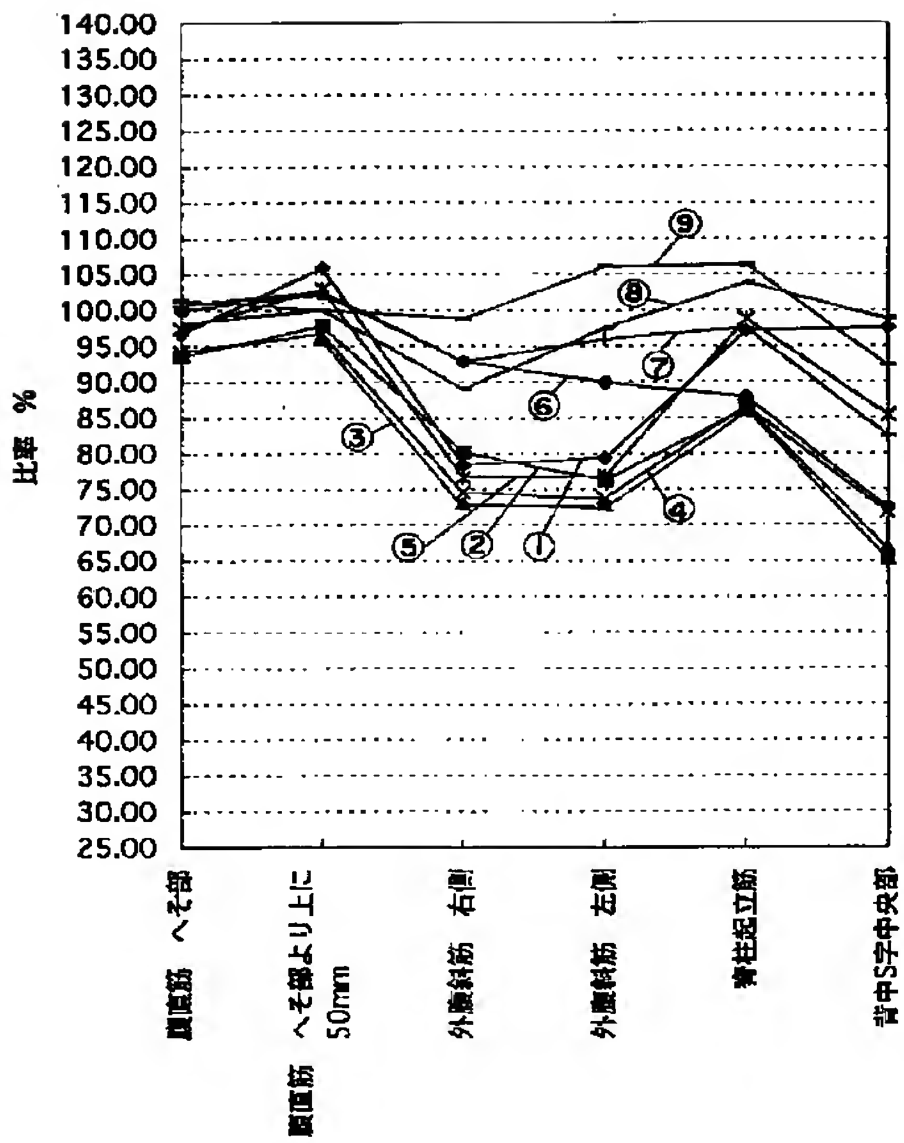
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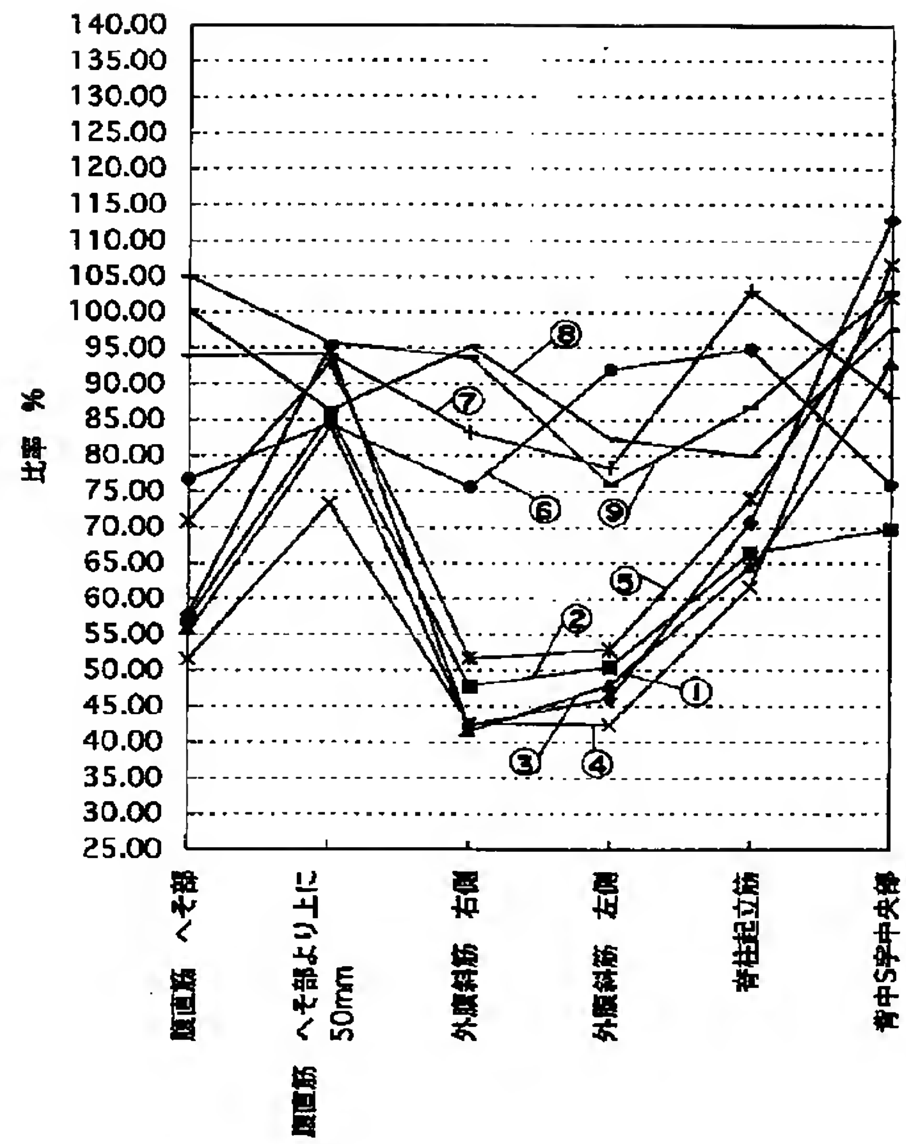
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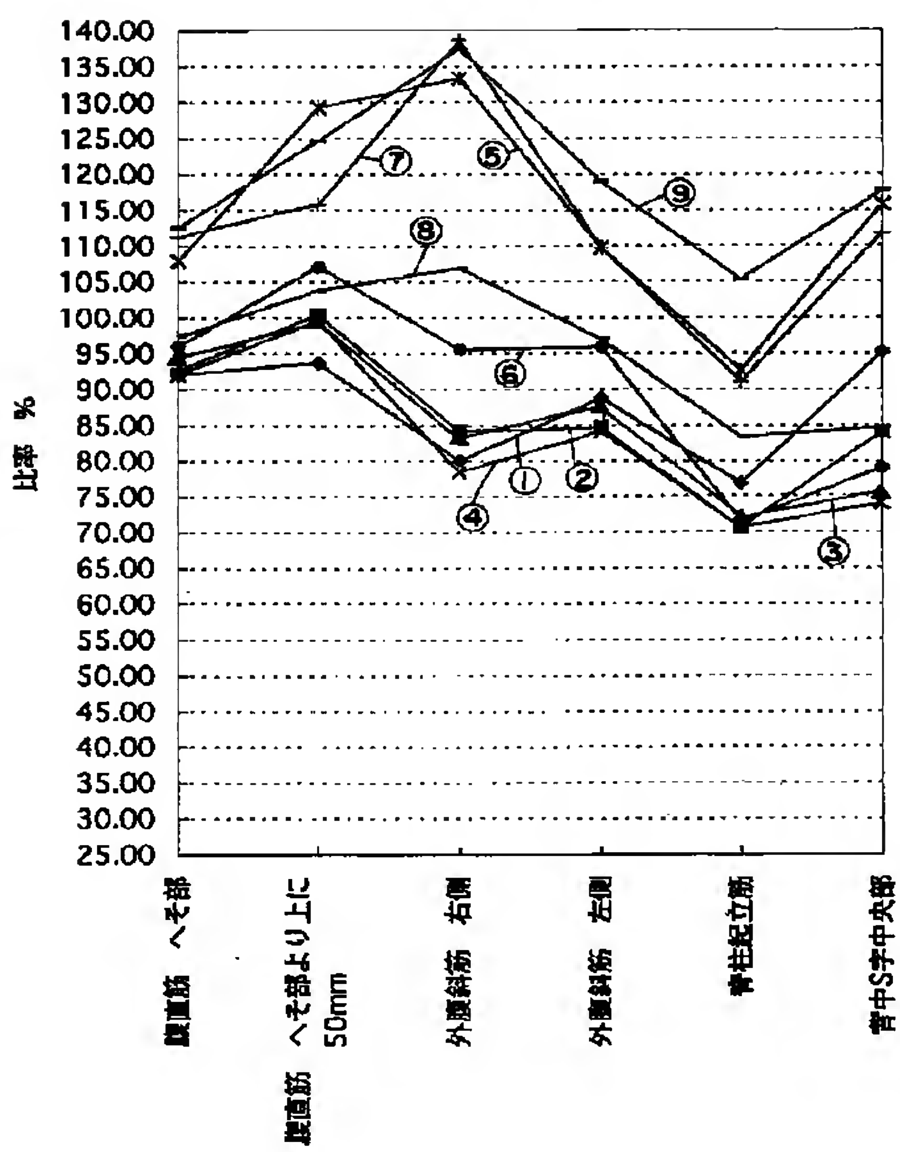
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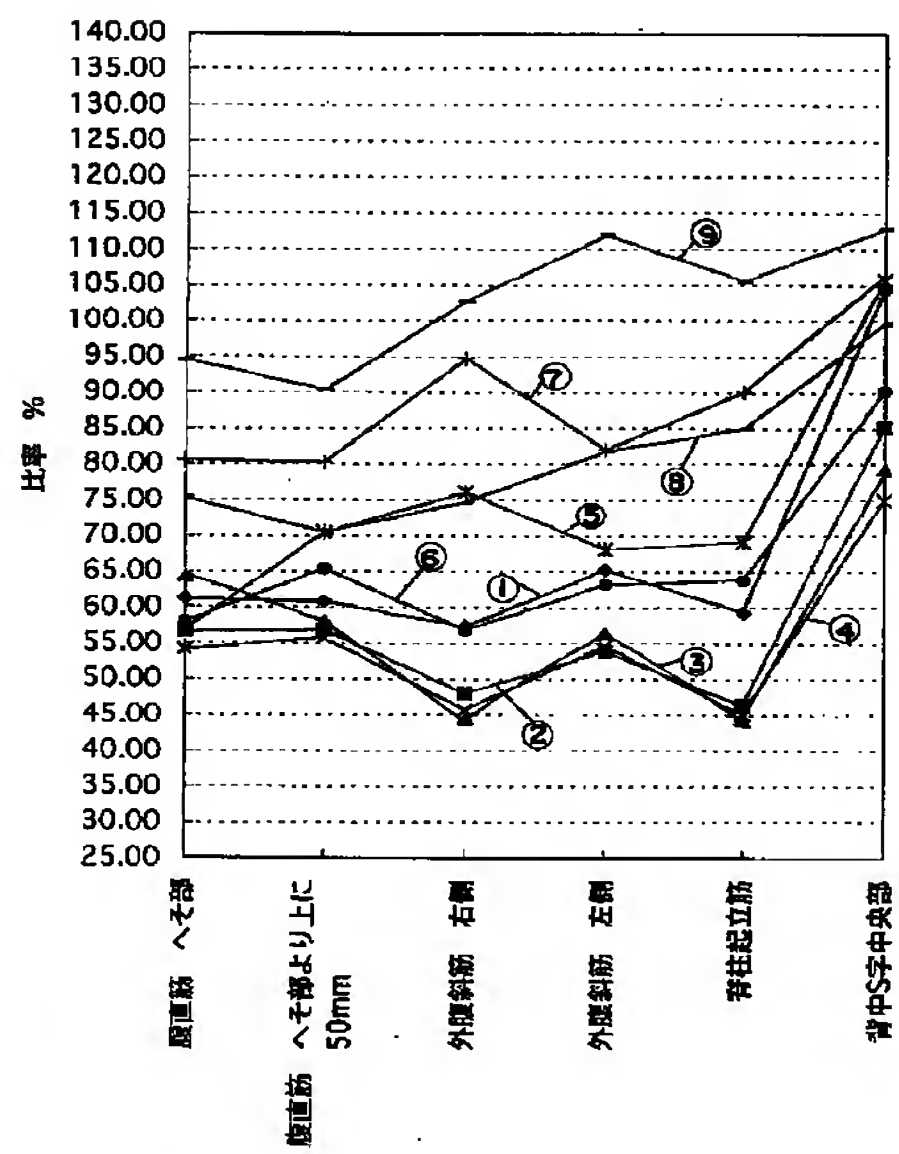
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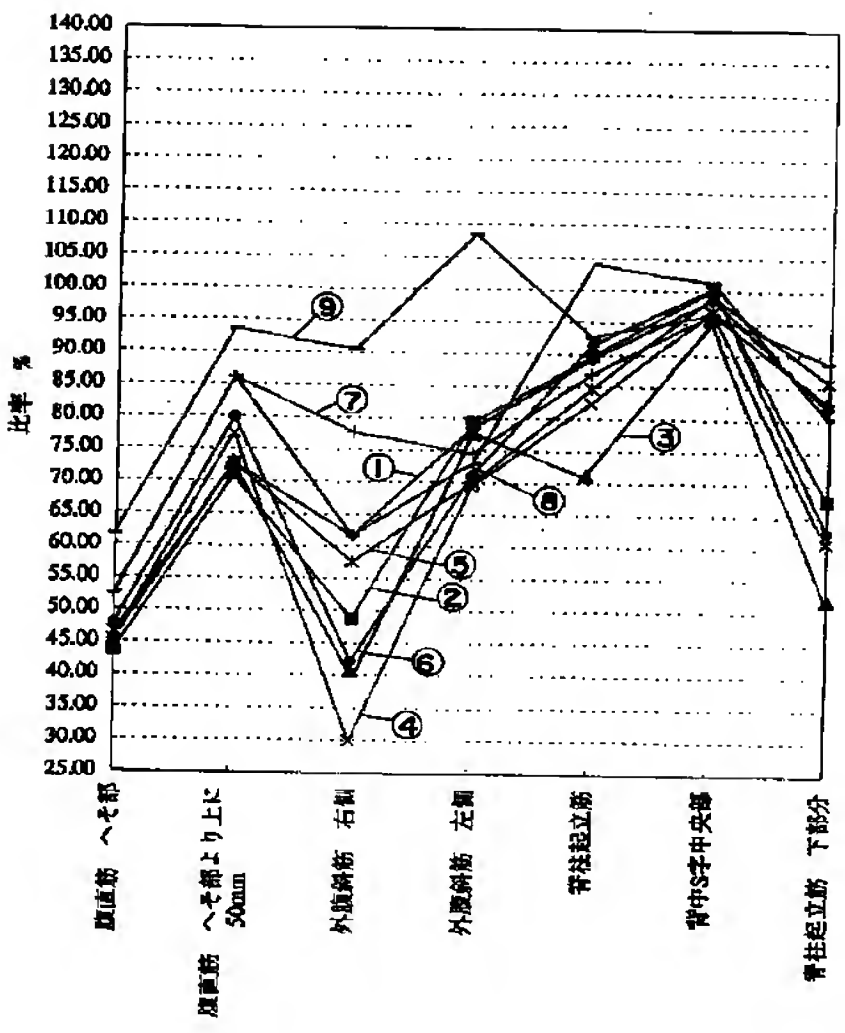
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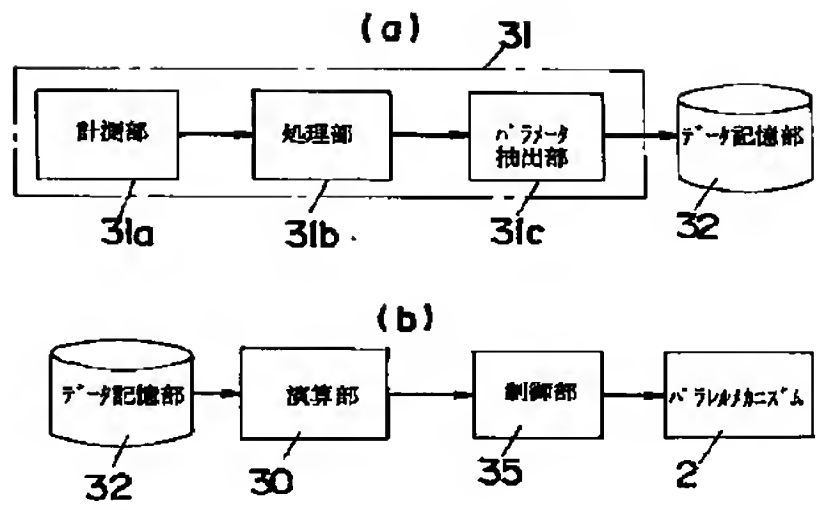
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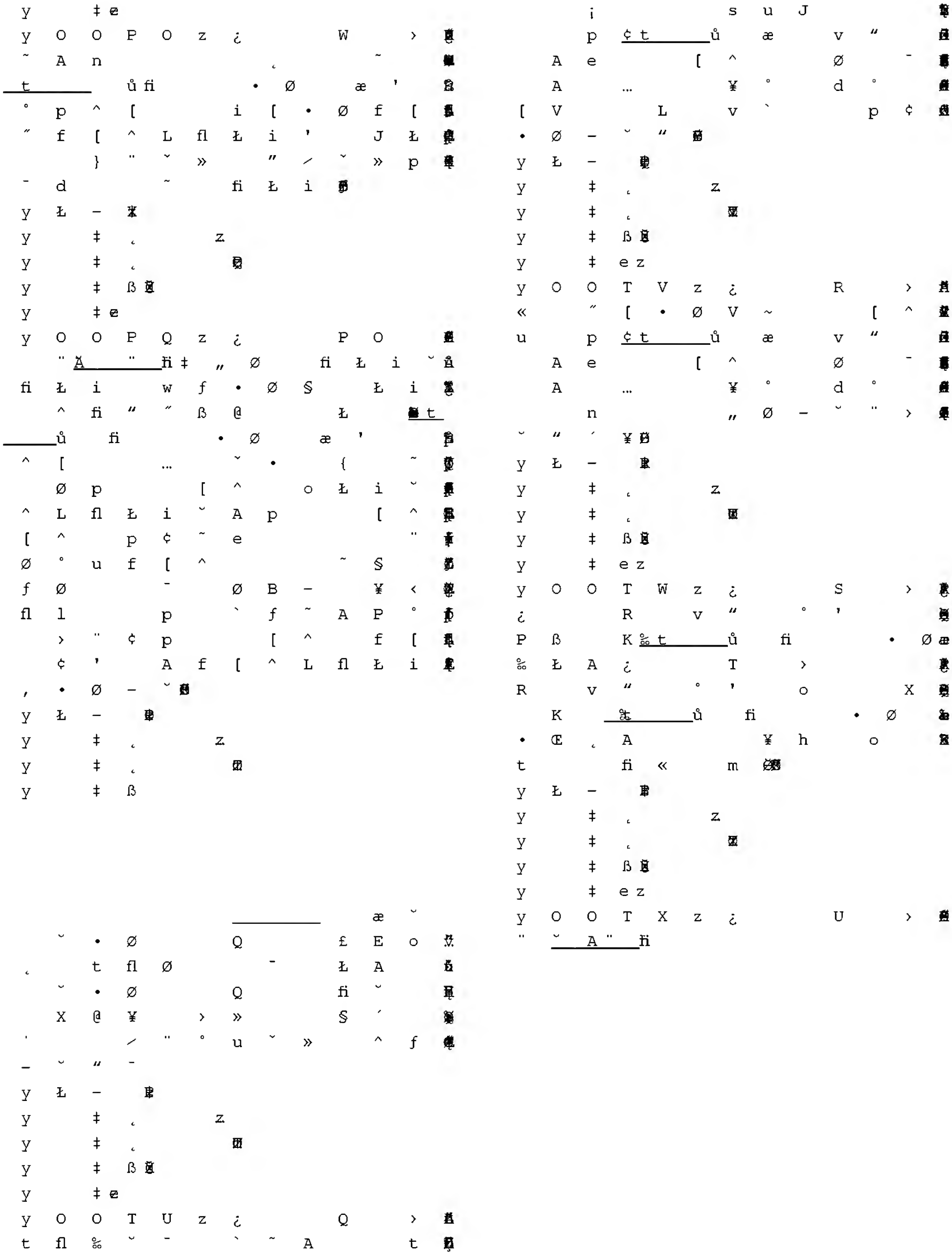

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